OBSERVATIONS UPON THE APPARENT CURVE OF THE SAGITTAL SUTURE IN VERTEX PRESENTATIONS.

BY

CHAS. F. WITHINGTON, M.D. (Harv.),
Boston.
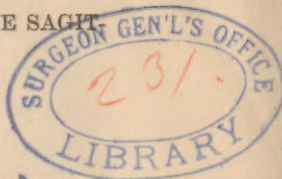
THE importance of being able to recognize by digital examination the exact position of the presenting head with reference to the maternal pelvis, is sufficiently insisted upon by all obstetrical writers as being essential at once to the proper apprehension of the successive stages in the mechanism of normal labor, and also to the intelligent application of the forceps or any other artificial aid that may be necessary. Yet it cannot be denied that a very large number of practitioners habitually conduct labors without obtaining from their successive examinations any distinct idea of the relation of the sagittal suture to the different parts of the pelvis, and not infrequently neglect to gain this information even before using the forceps. The ability to make this diagnosis is not altogether easy to gain, by reason of certain disturbing elements in the problem which have not, to the writer's knowledge, been alluded to in the current text-books, and which will repay investigation.

As every one knows, the chief guide to a knowledge of the position of the head is in the sagittal suture, which extends from the posterior or blunt angle of the anterior fontanelle to the anterior angle of the posterior fontanelle. The examining finger, extended through the partially dilated cervix to the presenting head, usually finds somewhere within the circle of the os some portion of this suture, which appears as a curve passing across from one lip of the os to the other. For ourpurpose, we may consider the head to be a sphere, on the surface of which is cut the segment of a great circle with sufficient distinctness to be readily palpable, even in many cases through intervening membranes. The considerations to be now advanced may, perhaps, be more readily followed if the reader will make use, either in imagination or in reality, of a ball, hav-

ing an arc of a great circle described upon it. The circle of the
os may be represented by the circumference of a round hole
cut in a piece of cardboard, which is held with the central point
of its orifice tangential to the sphere. If the finger be allowed
to trace the portion of the great circle included within the
circle of cardboard, it will be of assistance in verifying some
of the points to be referred to.

A portion of the curve of the suture can be felt during labor
by the finger through the circle of the os. From this portion
of the curve the observer is obliged mentally to construct the
remainder of it. In order to do this, he must consciously or
unconsciously *project* that curve upon the plane of the os, or,
as will be seen below to amount to the same thing, on the
plane which, for the time being, is tangential to the most ad-
vanced point of the head. Geometrically this is done by drop-
ping perpendiculars from the successive points of this curve
upon the plane. The bases of these perpendiculars, taken to-
gether, indicate the line of the projected curve. Now, it is
evident that if the plane of the suture is so placed as to be per-
pendicular to the plane of the os, the projection upon the latter
of the curve of the suture will be a straight line. This
straight line passes through the centre of that circle which
would be formed by the projection of the whole sphere upon
the tangential plane. Consequently, the rectilinear projection
of the suture passes through the middle point of the plane of
the os, or nearly so. The problem of determining from a certain
accessible portion of a line the remainder of it, is, of course,
much easier if the given line be straight than if it be curved.
If, then, the curve of the sagittal suture touches the plane of
the os, in which case it is perpendicular to it, the projection of
the curve is a straight line, and the conditions are most favor-
able for easily prolonging that line beyond the limits of the os
on each side, determining definitely the direction of the two
fontanelles, and, by adding the knowledge of their distance
apart from one another, diagnosticating definitely their posi-
tion.

Suppose, however (and this is what is generally the case),
the plane of the suture is not perpendicular to that of the os,
then the projection of that curve, instead of being a straight
line, is a curve which no longer passes through the centre of the

plane of the os. The nearer the suture comes to being tangential to the plane of the os, and the more nearly perpendicular the two planes to each other, the greater is the radius of the projected curve, and the nearer that curve is to a straight line ; while the more obliquely the two planes cut each other, the further the projection of the suture lies from the centre of the circle of the os, and the shorter the radius of its curve. Moreover, the concavity of the projected curve always looks toward the larger of the two portions into which it divides the circle of the os (vd. Fig. 1).

If the projection of the suture is a curved line and one capable from one period of the labor to another of altering its radius of curvature, it is plain that there is much greater difficulty in prolonging in imagination that curve beyond the
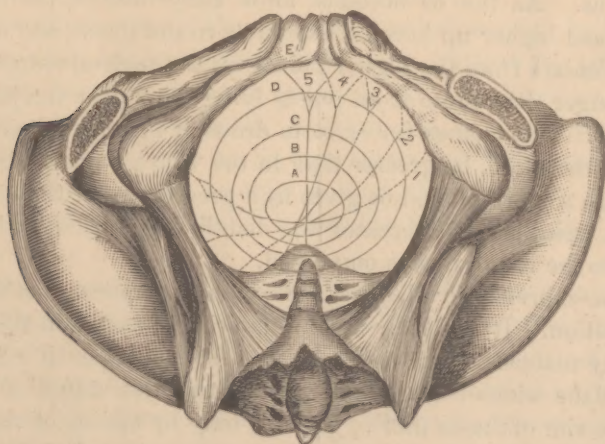

Fig. 1.

Fig. 1.—Diagram representing curve of sagittal suture projected upon various pelvic planes, seen from below; *a, b, c, d,* and *e* represent different degrees of dilatation of the os. 1, 2, 3, 4, and 5 successive degrees of rotation. The curve in each case is prolonged by a dotted line beyond the limits of the dilatation which corresponds with its particular extent of rotation. The curves, it will be noted (the position being O. L. A.), have their concavity forward and to the right. The gradual disappearance of the anterior fontanelle and advance of the posterior towards the reach of the examining finger, shows the increasing flexion of the head.

limits of the os than if the projection were a straight line. Now it will presently appear that this rectilinear projection of the suture is possible only after rotation is complete, and that before that time the plane of the suture is never perpendicular

to the plane of the os, so that the projection is always curvi-
linear during the whole progress of the rotation.

Of course, the accoucheur, during actual labor, possessing, as
he does, no better instrument of precision than his finger, can-
not carry out the process we have described with anything
like the accuracy of a geometrical method; but unless he is
able in a rough way to project the curve of the sagittal suture
upon the plane of the os, he can form no adequate idea of the
direction of the long diameter of the head across the mother's
pelvis. The secret then of accuracy in diagnosticating
position consists in the ability to describe with the finger-tip
perpendicular lines from the various accessible points of the
sagittal suture to the plane of the os, and to estimate the
position of the line in that plane to which these perpendiculars
lead us. As the os becomes more fully dilated, portions of
the head higher up become accessible to the touch, and the per-
pendiculars from the higher points on the sagittal suture must
be longer than those from points lying in or near the plane of
the os. The chance for error in drawing these perpendiculars
must, therefore, be greater than in the shorter ones. So that
though a more dilated os gives us a greater arc of the circle to
work from, it also increases the liability to mistake which is
due to the rough means employed.

The expression " plane of the os," now requires further con-
sideration. It evidently has no material existence in the form
of any maternal structure. As used in this paper it refers to
the plane which corresponds, during the first stages of labor,
to the rim of the os uteri. As it is only by feeling of the edge
of the lips of the os that the examiner can locate the position
of that plane upon which he must project the curve of the
suture, the less the amount of dilatation the easier it is to
recognize the data for determining that plane. On the other
hand, when dilatation is complete so that the uterine lip can
no longer be felt, the plane of the os can be defined only as
that particular pelvic plane which for the time being happens to
be tangential to the fetal head. Now, it is important to re-
member the constant change of direction of these planes due
to the unequal length of the anterior and posterior pelvic
walls, and the constantly changing direction of the pelvic axis.
From the time when the fetal head engages at the superior

pelvic strait until it comes in sight at the vulvar orifice it undergoes a revolution upon a horizontal transverse axis of about 90°. By reason of the progress of the head down through the pelvic canal which is going on simultaneously with this revolution it happens that it revolves not about its own intrinsic axis (as is the case in the manœuvre technically known as " rotation," to be referred to hereafter), but about a point in a horizontal line outside the sphere, corresponding in position probably nearly to the inner side of the pubic symphysis. Hence we have termed this motion a *revolution* as distinguished from the " rotation," technically and properly called, of the head about its own vertical axis. This axis of rotation, however, on account of the synchronism of the rotation with the revolution just spoken of, is constantly changing its direction through an arc amounting in all to about 90°.

For an illustration of these relative motions we may look not to the rotation and revolution of the earth, because the axis of that body remains constant or nearly so. If, however, the diurnal rotation of the earth remaining as it is, we were to imagine the earth's axis to be constantly pointed toward the sun, we should have an example in kind, though by no means in relative degree, of the two circular motions of the fetal head.

These two motions, though occurring simultaneously, require to be estimated separately by the accoucheur. The revolution of the head is about a centre which is pretty nearly coincident with that part of the head most readily within reach of the examining finger. In any revolving system, of course, the amount of motion is less in proportion as we approach its centre of revolution. If we place the finger at the lowermost point of a sphere, and then, keeping the finger motionless, revolve the sphere around that point 90° backward, we shall see that but little impression has been communicated to the finger of a motion which has brought the centre of the sphere from a point directly above to a point directly behind the finger (vd. Fig. 2). So in the successive examinations during the expulsive stage of labor, while the finger is always passing in the same direction and is constantly impinging on nearly the same part of the head, it is difficult to appreciate the fact that during this time the direction of the centre of the head from the finger tip has

entirely changed, the arc of revolution being about 90°. The information obtained through the finger, then, requires to be supplemented by a knowledge of about the angle of that plane of the pelvis which from time to time becomes tangential to the advancing head, and upon which consequently the sagittal suture is to be projected. It is fortunate that a moderate error in the location of this plane is not fatal to an exactness in diagnosis of position sufficient for practical purposes.

Now on examining the phenomenon of rotation as affecting the direction of the sagittal curve, we first notice an aid to the diagnosis of position, in the fact that the pole of the axis lies

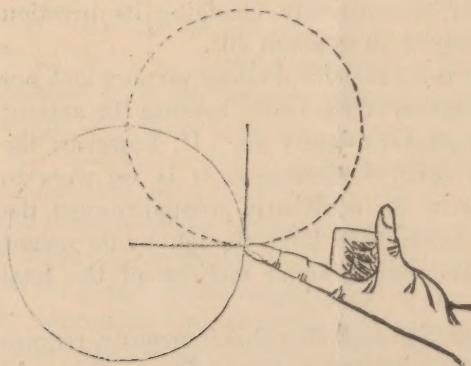

FIG. 2.   FIG. 3.

constantly at about the mid-point from side to side of the pelvis. Hence the finger examining *per vaginam* impinges upon the sagittal suture at a point very near the pole of rotation. If from this pole the finger, during the process of rotation, makes from time to time a short excursion in either direction along the meridian of the sagittal suture, a change in direction of that meridian corresponding to the degree of rotation is evinced in two ways, viz.: by a progress or motion (for example), from left to right of that portion of the meridian which lies on one side the pole, and also by a simultaneous retrogression or motion from right to left of that part of the meridian lying on the other side of the pole (vd. Fig. 3).

But it must be remembered that as the head comes down through the successive pelvic planes, what is the lowest point with

reference to them, that is, what is the first point to reach them, is not the lowest point with reference to the horizontal pl ne by which the examiner instinctively judges of " high " and " low." Let us suppose the woman to be lying upon her back and let directions be indicated as right or left, according to the corresponding side of the mother, upward or downward from a horizontal plane, and headward or footward from a vertical transverse plane. Suppose the head to be at the pelvic brim and the position exactly transverse. Then the polar point on the sagittal suture is absolutely the lowest point of that suture, but not the lowest point of the sphere, which is (supposing the inclination of the plane of the brim to the horizon, the woman being recumbent, to be 30°), 30° distant from that pole. From the latter point the finger tracing the sagittal suture passes either to right or left, upward and headward. If, however, the position is not exactly transverse, the pole is no longer the lowest point of the suture, and thus, while one is tracing the suture in a continuous line from the pole, he may be surprised to discover a change in direction as he reaches this lowest point and passes up beyond it. A condensed statement of the direction traversed by the examining finger in passing from the pole in the various positions at the pelvic brim is as follows:

O. L. A. } *right*, downward, then upward, headward ;
and O. R. P. } *left*, upward, footward.

O. R. A. } *right*, upward, footward ;
and O. L. P. } *left*, downward then upward, headward.

Were it possible for the sagittal suture to lie in the sagittal plane of the mother's body while the head was still at the brim, it is obvious that the examining finger, as it moved from its pole footward, would pass downward over an arc of 30° to reach the lowest point of the suture, which would then coincide with the lowest point of the sphere. On the other hand, to reach the most " *footward* " point of the suture and of the head, the finger would have to traverse an arc of 60°. But in point of fact, while the process of rotation is bringing the plane of the sagittal suture more and more toward coincidence with the sagittal plane of the mother's body, a concurrent process is so altering the direction of the axis that the pole is departing further and further from the lowest point of

the great circle, and approximating more and more to its most footward point.

The alteration in direction of the axis of rotation is not, however, sufficiently rapid to keep that axis perpendicular to the successive pelvic planes as they become tangential to the fetal head. Whether we hold that the head on entering the pelvic brim is synclitical, *i. e.* (having its biparietal diameter parallel with the plane of the brim), or asynclitical, in either case the initial degree of inclination of the axis remains unaltered until the most advanced portion of the head has passed some distance into the pelvic canal; probably, indeed, until the maximum diameter of the head comes to the plane of the brim. During all this time, the plane of the suture has been perpendicular to no one of these successively tangential planes, except only (on the synclitical view), the plane of the brim. So that it is only at the brim that the projection of the curve of the suture upon the plane of the os is a straight line. From that moment on until rotation has become complete, the projection is always a curve, having its concavity forward, and when the head occupies the right oblique diameter of the pelvis, to the right, while, when the head lies in the left oblique pelvic diameter, the concavity of the projected curve looks toward the left (Fig. 1).

It is not until rotation is complete that the plane of the sagittal suture becomes perpendicular to the tangential plane of the head; but this holds true alike whether rotation be early or late, and for all possible pelvic planes after it occurs the projection of the curve is a straight line. Of course, as the rotation is approximating completion, the projected curve is approximating a straight line. But it remains a fact that the only circumstances under which this projected line is rectilinear are, on the one hand, while the head is tangential to the place of the brim (a condition which has ceased before the degree of dilatation admits of recognition of the suture by the finger) and, on the other hand, after rotation is complete.